**C** **B4C052** **Pages: 2**

Reg. No._____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

FOURTH SEMESTER B.TECH DEGREE EXAMINATION JUNE 17

Course code**: CH 204**

Course Name**: CHEMICAL ENGINEERING THERMODYNAMICS (CH)**

Max. Marks: 100 Duration: 3 Hours

## PART A

***Answer any TWO questions.***

1. a. What are Irreversibility and Availability in a Process? (3)
   b. State mathematically the first law of thermodynamics used for solving steady state fluid flow problems. (4)
   c. One kilo mole of a gas for which PV= nRT, where R= 8.314 kJ/kmol K is originally at 300 K and 1bar. It is then heated at constant pressure to a temperature of 400 K and compressed isothermally to a volume equal to its initial volume. Assume that Cp= 30 kJ/kmol K. Find ΔU, ΔH, Q and W. (8)
2. a. State First Law of Thermodynamics. (2)
   b. Derive an equation for velocity and area of cross section of flow through nozzles. (5)
   c. What are the desirable properties of a refrigerant? (2)
   d. Steam at 700 kPa and 553 K enters a nozzle with negligible velocity and discharge at a pressure of 475 kPa. Determine (i) the exit velocity (ii) the cross sectional area for rate of 0.5 kg/s. (6)
3. a. Derive Clapeyron equation from the fundamental differential equations. (5)
   b. What is the importance of Gibbs- Helmholz equation? How would you obtain an equation for the free energy as a function of temperature using the Gibbs- helmholz equation? (5)
   c. Using the virial equation calculate the molar volume and compressibility factor of isopropanol vapour at 473 K and 10 bar. The Virial Coefficients are: B= $-3.88 \times 10^{-4}$ $m^3/mol$ C= $-2.6 \times 10^{-8}$ $m^6/mol^2$. (5)

## PART B

***Answer any TWO questions.***

4. a. What are the Characteristics of Ideal Solution? (2)
   b. Define Activity Coefficient. What is the effect of Temperature and Pressure on Activity coefficient? (6)
   c. State Henry's Law. And show that Raoult's Law is a special case of Henry's Law. (5)
   d. Define Partial Molar Properties of a component in a mixture of solution. (2)

5. The following values refer to the Wilson parameters for the system acetone (1): Water (2): $a_{12}$= 1225.31 J/mol, $a_{21}$= 6051.01 J/mol, $V_1$= 74.05 x $10^{-6}$ $m^3$/mol, $V_2$= 18.07 x $10^{-6}$ $m^3$/mol. The vapour pressure are given by ln $P_1^S$= 14.39155- $\frac{2795.817}{T-43.198}$,

   ln $P_2^S$ = 16.26205- $\frac{3799.887}{T-46.854}$ Where P is in kPa and T is in K. Calculate the equilibrium pressure and composition of:

   i) Vapour in equilibrium with a liquid of composition $x_1$= 0.43 at 349K.
   ii) The liquid in equilibrium with a vapour of concentration $y_1$ = 0.8 at 349 K. (15)

6. a. Write UNIQUAC and NRTL Equation. Mention its significance. (6)

   b). How you test the Consistency of VLE data by:
   i) Using Slope of ln γ curves.
   ii) Using data at the Mid- point.
   iii) Using RedlichKister Method? (9)

## PART C

***Answer any TWO questions.***

7. a. A multi component liquid mixture of known composition is flash vaporised at a given pressure and temperature. How would you estimate the fraction of the liquid vaporised? (5)

   b. Write the bubble point and dew point calculation procedure for multi component distillation. (15)

8. a. Derive the relation between standard free energy change and equilibrium constant (8)

   b. Write the vaporisation equilibrium constants. (5)

   c. Write the various factors affecting equilibrium conversions. (7)

9. a. Write the principle of steam distillation and phase equilibrium consideration in steam distillation. (15)

   b. What are the various methods used to determine the equilibrium constant. (5)

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